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DE	198 14 212	C1
DE	195 08 797	C1
DE	195 41 000	A1
GB	11 23 128	
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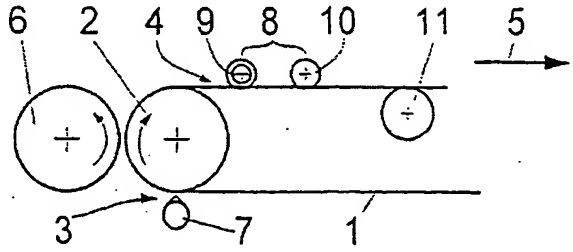
Wochenblatt für Papierfabrikation[1] 23/24, 1987, p. 1065 ff.;
Patent Abstracts of Japan, Publ. no. 08080467 A, Mar. 26, 1996;

The following statements were taken from the documents submitted by the applicant

Petition for examination requested according to § 44 of the Patent Act

54 Device for the Application of an Abrasive Coating Material onto a Paper Web Passing Through

57 It is known to apply a coating material, which comprises abrasive particles, onto a paper web passing through by means of a slot die, to meter it by means of a metering roller, and leveled by means of a flap of a flexible material mounted on one side, lying loosely on the paper web passing through. It has, though, emerged that as a function of the consistency of the coating material one does not always succeed in smoothening an uneven coating profile caused by surface tension such that an undesired stripe pattern is no longer visible.



With the new device, the leveling mechanism (8) includes a texturing roller (9), the enveloping surface of which has a screw-like structure. The longitudinal stripes caused by an uneven coating profile are smeared laterally by that, so that they are no longer visible on the finished product (Figure 1).

[1] *Weekly Publication of the Paper Manufacture*

Description

The invention concerns a device for the application of a fluid coating material consisting of resin and fine-grain abrasive material, in particular corundum, onto a paper web passing through, which is intended for use in the manufacture of wear-resistant laminates, in accordance with the preamble of claim 1.

DE 195 08 797 C1 describes a process for the production of decorative paper intended to be used in the production of wear-resistant laminates. One thereby applies a viscous mixture of melamine resin and alpha-cellulose to which corundum particles have been added as a coating material onto the visible surface of a decorative paper. The alpha-cellulose thereby serves as stiffening and suspending agent. The corundum particles have a particle size of 15-50 μm. The application quantity is 80-200 g/m^2, so that after reaching the final moisture content, a layer thickness results of 20-65 μm. The coating material must be applied with a wire doctor blade, a reverse coating system or a halftone roller.

A device is described in DE 198 14 212 C1, which is intended especially for the application of such a coating material. The invention builds on this device, which has proven successful on an industrial scale already for some time. With the known device, the metering roller is synchronized with the guide roller, so that at the metering gap, the surface velocities of the two rollers coincide in terms of magnitude and direction. There is thus no relative velocity between the metering roller and the coating material adhering to the paper web. By that one minimizes as much as possible the wear of the metering roller through the abrasive particles comprised in the coating material. From the document, though, one gathers that the synchronization of the two rollers causes another problem: Contrary to a counter-rotating metering roller, the layer already adhering to the paper web is split between the metering roller and guide roller, so that a portion of the coating material remains adhering to the paper web, another portion is entrained by the metering roller. After the paper web has passed through the roller gap, the adhering layer is at first still uneven, so that longitudinal stripes are still visible. A leveling, in particular a doctor blade, consisting of an essentially rectangular flap of a flexible, rubber-like material, which at its rear edge, [which is] parallel to the axis of both rollers, is fastened

on one side to a support strip and lies loosely on the upper side of the paper web coming off the guide roller.

But depending on the consistency of the coating material, which may exhibit appreciable differences due to the different formulations of the individual manufacturers, such a flap is not always sufficient for making the undesired stripe pattern entirely invisible.

According to US-PS 19 39 012 one uses a screw for smoothing of a wet brick green bodies. A mold filled with wet clay is moved through underneath the rotating screw. Excess clay is thereby leveled off. It falls into chute located laterally and recirculated to a renewed utilization.

DE 195 41 000 A1 describes a device for the smoothening of gypsum fiberboards passing through, consisting essentially of a screw which is arranged transversely above a conveyor belt for the gypsum fiberboards passing through. In the manner of a scraper, the rotating screw removes from the surface passing through underneath of the already set gypsum fiberboard, which may still be wet or already dry, fine particles, which through the conveying effect of the screw are transported to the edge and fall there into a container.

It is the object of the invention to further develop a device according to the preamble of the claim 1, so that even when using coating materials difficult to process it provides uniformly coated papers without visible stripes.

In agreement with the characterizing feature of claim 1, the means for attaining this object are in that the leveling device includes at least one texturing roller, the enveloping surface of which has a screw-like structure.

Additional advantageous characteristics of the invention are subject matter of the claims 2 through 10.

The drawing serves in elucidating the invention by means of schematically represented examples of embodiment.

The **Fig.** 1 to 4 visualize various devices according to the invention.

The **Fig.** 5 to 7 visualize various texturing rollers.

According to **Fig. 1**, the paper web **1**, which is already pre-impregnated with resin, possibly also already dried, is fed in a horizontal direction to a guide roller **2**. It loops

around the guide roller **2** over an arc of 180°, limited at about the six-o'clock position by the feed line **3** and at the twelve-o'clock position by the exit line **4**. The paper web **1** then continues in horizontal direction, as symbolized by the arrow **5**, to a dryer that is not represented.

A metering roller **6** with a smooth outer surface is located next to the guide roller **2**. In the example of embodiment represented it has the same diameter as the guide roller **2**. The axes of the guide roller **2** and the metering roller **6** are bearing mounted parallel to one another, at the same height in a machine frame that is not represented. The mounting of one of the two rollers **2, 6** is displaceable in the horizontal direction, so that the width of the narrow gap present between the two rollers **2, 6** is variable. The metering roller **6**, the same as the guide roller **2**, is provided with a drive. The drives of the two rollers **2, 6** are coupled mechanically or electrically, so that the rollers **2, 6** revolve synchronously or nearly synchronously, that means preferably with a congruent surface velocity, which corresponds to the feed rate of the paper web.

A slot die **7** for the application of the coating material is arranged underneath the guide roller **2**. The slot die **7** is next to the feed line **3**.

A short distance from the exit line **4**, a leveling device **8** is arranged above the upper side of the unwrapping paper web **1**. It includes a texturing roller**9** and a smooth roller **10**, which in the feed direction of the web is located behind the texturing roller **9**. The structuring roller **9** and the smooth roller **10** are adjustable in height, so that their distances from the paper web **1** may be varied. Underneath the paper web **1**, a support roller **11** is located a short distance, which corresponds approximately to the distance of the roller **10** from the feed line **4**, behind the leveling device **8** seen in the direction of the arrow **5**.

The enveloping surface of the texturing roller **9** has a screw-like structure. The texturing roller visualized in **Fig.** 5 is provided with a helically-shaped groove **12**, which in accordance with the working width extends essentially over the entire length of the texturing roller **9**. The crest **13** remaining between neighboring roots is rectangular in its profile and has approximately the same width as the groove **12**. The enveloping surface has thus the structure of a single-start thread.

The texturing roller visualized in **Fig.** 6 differs herefrom in that it is provided with a multi-start, in particular a tri-start thread. The lead is increased accordingly, so is the lead angle, with the cross-section of the roots and crests being unmodified.

The texturing roller visualized in **Fig.** 7 is provided with a system of helically-shaped grooves with the same lead, of opposite screw sense. The system comprises three each of right-handed and left-handed grooves. The left-handed grooves correspond to the grooves illustrated in **Fig.** 6. Through the grooves intersecting one another one carves from the roller a flat pattern of diamond-shaped islands, reminiscent of ceramic tiling, the one diagonal of which is oriented parallel to the roller axis. The second diagonal lies at a right angle hereto.

With the device according to **Fig.** 1, the paper web **1** runs through during operation at a speed between 10 and 70 m/min, preferably between 20 and 50 m/min. The coating material, which consists of liquid resin and fine corundum particles suspended therein, is applied in excess from underneath with the slot die **7**, directly onto the paper web. In the narrow gap between the guide roller 2 and the metering roller 6, the layer formed in this way is split so that a portion of the coating material remains adhering to the paper, the other portion is carried on by the metering roller **6**. Excess coating material is accumulated in the gap and drips off. Since the surface velocities of the two rollers **2**, **6** have the same direction and are preferably at least nearly equally large, the abrasive particles comprised in the coating material cause no nominal wear for the metering roller **6**.

The layer adhering to the paper web, on average about 30 to 100 g/m^2, is at first uneven, so that longitudinal stripes are clearly visible. The stripes can be explained in that during the splitting of the layer in the roller gap, as a consequence of the surface tension, the fluid coating material has a tendency towards pulling together in certain locations distributed more or less evenly over the width. The profile of the layer adhering to the paper web has in these places maxima which appear as narrow stripes. From experience, the width of a strip is usually 5 mm. The spacing of two neighboring stripes lies mostly between about 10 and 30 mm. The undesired stripe pattern changes sometimes in unpredictable ways. The texturing roller **9** is adjusted so that it touches the paper web. The rapidly rotating structuring roller **9** in the example of embodiment

according to **Fig.** 5 or **Fig.** 6 has on the coating material accumulated in the stripes a conveying effect in the direction of its axis, that means transversely to the paper web **1**, comparable to screw. Prerequisite for this is naturally that the surface velocity of the texturing roller **9** in the area of contact considerably deviates from the velocity at which the paper web **1** moves in the direction of the arrow **5**. The conveying effect is directed unilaterally towards the one or the other edge of the paper web as a function of the direction of rotation in which the texturing roller **9** turns and the screw sense of the thread. The thickened stripes are thereby smeared so-to-speak in the transversal direction. No coating material is, though, removed from the paper web **1**. The texturing roller **9** has thus only a leveling effect, but no influence on the metering. For this reason, contrary to the metering roller **6**, with the texturing roller **9** an extreme dimensional accuracy is not necessary. A certain wear has hardly any influence on the efficiency of the texturing roller **9**. The texturing roller **9** consequently does not generate particularly high costs.

The smooth roller **10** that follows, also rotating at a high speed, effects an additional leveling.

Through the guide roller **2** and the support roller **11** following after a relatively short distance, the sag of the paper web **1**, which during operation is usually under a certain tension, is reduced in the leveling device **8** to an unnoticeable size.

With the device according to **Fig.** 1 one may use as texturing roller **9** also a roller, the enveloping surface of which has the structure visualized in **Fig.** 7. When seen in the direction of the surface velocity, the coating material accumulated in the stripes is thereby removed by the leading edges of the diamond-shaped islands **14**, [oriented] at an oblique angle with respect to the surface velocity, in part towards the one and in part to the other side. By that one achieves a uniform distribution.

The example of embodiment visualized in **Fig.** 2 differs from the example of embodiment just described in **Fig.** 1 in particular in that the leveling device **8** includes two texturing rollers **9**, **9a** arranged one after another. A further difference consists in that the slot die **7** is associated with the metering roller **6**.

In the example of embodiment according to **Fig.** 3, the leveling device includes a doctor blade **15**, which in the web path is arranged ahead of the texturing roller **9**. It consists of an essentially rectangular flap **16** of a flexible, rubber-like material, which at

its rear edge, [which is] parallel to the axis of structuring roller **9**, is fastened on one side to a support strip **17** and lies loosely on the upper side of the paper web **1** coming off the guide roller **2**. The flap **16** causes already a certain pre-leveling. The example of embodiment according to **Fig.** 3 is furthermore different from the examples of embodiment described previously in detail in that a similar doctor blade **18** is associated with the metering roller **6**, and in particular on the side facing away from the guide roller **2**. Hung from one side of it there is a flexible, rectangular flap **20** of synthetic material. The front end portion of the flap **6** lies loosely on the metering roller **6**. The coating material adhering to the metering roller **6** is leveled by the flap **20**. Through this one prevents that an uneven profile of the layer adhering to the metering roller **6** is transferred onto the coating of the paper web **1**.

The example of embodiment visualized in **Fig.** 3a differs from that of the **Fig.** 3 in that, seen in the feed direction, the doctor blade **15** is arranged behind the texturing roller **9**, so that the flap **16** lies on the paper web **1**, above the support roller **11**. Diagonally running stripes, if any, still visible following the texturing roller **9** are smoothened by the flap **16**.

In the example of embodiment according to **Fig.** 4, the metering roller **6** is arranged nearly perpendicularly above the guide roller **2**, at about the eleven o'clock position. The paper web consequently runs between the metering and the leveling over only a relatively short distance and requires for it only a correspondingly short time interval. As shown by experiments, this has a positive influence on the leveling.

Patent Claims

1. Device for the application of a fluid coating material consisting of resin and fine-grain abrasive material, in particular corundum, onto a paper web passing through, which is intended for use in the manufacture of wear-resistant laminates, with a guide roller against which the paper web lies in the wrap-around area,
with a metering roller which is arranged parallel to the guide roller and with it encloses a narrow gap,
with a slot gap for the application of the coating material, either directly onto the paper web lying against the guide roller or onto the metering roller, and with a device for the

leveling of the freshly applied coating material, **characterized in** that the leveling device (**8**) includes at least one texturing roller (**9**, **9a**), the enveloping surface of which has a screw-like structure.

2. Device according to claim 1, characterized in that the texturing roller (**9**, **9a**) is provided with a multi-start thread.

3. Device according to claim 1 or 2, characterized in that the texturing roller (**9**, **9a**) [...][2] with a system of helically-shaped groves crossing one another.

4. Device according to one of the claims 1 through 3, characterized in that the leveling device (**8**) includes at least two texturing rollers (**9**, **9a**).

5. Device according to one of the claims 1 through 4, characterized in that the leveling device (**8**) includes a doctor blade (**15**), which in the path of the web is arranged ahead or after the texturing roller(s) (**9**, **9a**), and an essentially rectangular flap (**16**) of a flexible, rubber-like material, which at its rear edge, [which is] parallel to the axis of the texturing roller(s) (**9**, **9a**), is fastened on one side and lies loosely on the upper side of the paper web (**1**) coming off the guide roller (**2**).

6. Device according to one of the claims 1 through 5, characterized in that the leveling device (**8**) includes a smooth roller (**10**), which in the direction of the web path is arranged following the texturing roller(s) (**9**, **9a**).

7. Device according to one of the claims 1 through 6, characterized in that support elements (**2**, **11**) for the paper web (**1**) are arranged a short distance ahead and behind the area in which the leveling device (**8**) interacts with the paper web (**1**).

8. Device according to one of the claim 7, characterized in that the guide roller (**2**) forms the one support element and that an additional support roller (**11**) is provided as the second support element.

9. Device according to one of the claims 1 through 8, characterized in that in the case of a horizontal guiding of the side of the paper web (**1**) coming off the guide roller (**2**), the metering roller (**6**) is arranged perpendicularly or nearly perpendicularly above the guide roller (**2**).

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[2] verb missing in the original; *versehen ist = is provided* may have been intended at the end of the sentence in the original.

10. Device according to one of the claims 1 through 9, characterized in that the metering roller (**6**) is associated with a doctor blade (**18**).

Hereto 2 page(s) of drawings